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(71) Applicant: **Murata Manufacturing Co., Ltd.**
Nagaokakyo-shi Kyoto-fu 617-8555 (JP)

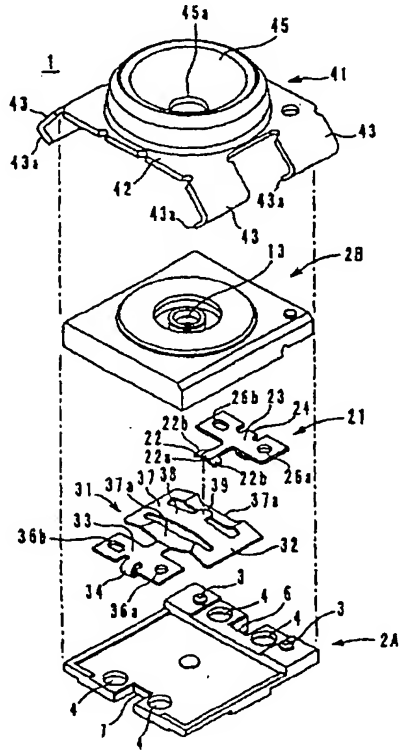
(72) Inventors:
- **Shima, Kazuo, c/o (A170) Intellectual Prop. Dept.**
Nagaokakyo-shi, Kyoto-fu 617-8555 (JP)
- **Uratani, Chikara, (A170) Intellectual Prop. Dept.**
Nagaokakyo-shi, Kyoto-fu 617-8555 (JP)
- **Maruyama, Yuichi,**
(A170) Intellectual Prop. Dept.
Nagaokakyo-shi, Kyoto-fu 617-8555 (JP)

(74) Representative: **Thévenet, Jean-Bruno et al**
Cabinet Beau de Loménie
158, rue de l'Université
75340 Paris Cédex 07 (FR)

(54) Movable terminal, coaxial connector, and communications apparatus incorporating the same

(57) The present invention provides a movable terminal (31), a coaxial connector (1), which are durable and have good contact/connection reliability, and a communications apparatus incorporating the same. A coaxial connector (1) is formed by a two-part-split synthetic resin case having a lower insulating case (2A) and an upper insulating case (2B), a metal fixed terminal (21), a movable terminal (31), and an external terminal (41). The movable terminal (31) having a spring movable (resilient) function is composed of a movable contact portion (32) with which the fixed terminal (21) makes contact, a fixed portion (33) fit in the upper and lower insulating cases, and a lead portion (34) bent in an L-shape. The movable contact portion (32) has a frame portion (37), a spring movable (resilient) portion (38) upwardly curved in a circular form, and a contact portion (39) formed at the center of the spring movable portion (38).

FIG. 1



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BRIEF DESCRIPTION OF THE DRAWINGS

[0012] Further features and advantages of the present invention will become apparent from the following description of preferred embodiments thereof, given by way of example, and illustrated by the annexed drawings, in which:

Fig. 1 is an exploded perspective view showing an embodiment of a coaxial connector according to the present invention;
Fig. 2 is an enlarged perspective view of a movable terminal shown in Fig. 1;
Fig. 3 is a front view of the movable terminal shown in Fig. 2;
Fig. 4 is a right side-surface view of the movable terminal shown in Fig. 2;
Fig. 5 is a left side-surface view of the movable terminal shown in Fig. 2;
Fig. 6 is a perspective view showing the appearance of the coaxial connector shown in Fig. 1;
Fig. 7 is a sectional view of the coaxial connector shown in Fig. 6;
Fig. 8 is a schematic sectional view for illustrating the spring function (elasticity) of a resilient movable portion of the movable terminal;
Fig. 9 is a sectional view obtained when a counterpart coaxial connector is fitted in the coaxial connector shown in Fig. 6;
Fig. 10 is a schematic sectional view for illustrating the spring function (elasticity) of the resilient movable portion of the movable terminal in the above situation;
Fig. 11 is a block diagram of an embodiment of a communication apparatus according to the present invention; and
Fig. 12 is a perspective view showing a conventional movable terminal and a conventional fixed terminal.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0013] With reference to the attached drawings, a description will be given of a movable terminal, a coaxial connector, and a communications apparatus according to embodiments of the present invention.

[First embodiment: Figs. 1 to 10]

[0014] Fig. 1 is an exploded perspective view showing the structure of a coaxial connector according to an embodiment of the present invention. A coaxial connector (coaxial receptacle) 1 is composed of a synthetic resin insulating case split into a lower insulating case 2A and an upper insulating case 2B, a metal fixed terminal 21, a metal movable terminal 31, and a metal external terminal (an external conductor) 41.

[0015] The lower insulating case 2A has substantially a rectangular shape. At each of the two corners of one side of the upper surface (a split surface) of the lower insulating case 2A, a guide protrusion 3 for positioning the upper insulating case 2B is disposed. Near each of the guide protrusions 3, and on the opposite side of the lower insulating case 2A , cavity-like leg-receiving portions 4 for fitting the legs (not shown) of the upper insulating case 2B are provided. In addition, rectangular cut-away portions 6 and 7 are formed at the central parts of the mutually opposing edges of the lower insulating case 2A. The cut-away portion 6 contains a lead portion 24 (which will be described below) of the fixed terminal 21. The cut-away portion 7 contains a lead portion 34 (which will be described below) of the movable terminal 31. The dimensions of the cut-away portions 6 and 7 are set such that there is formed a clearance sufficient for preventing capillary effect due to the flux of solder used for mounting between the lower insulating case 2A and the lead portion 24 of the terminal 21 and the lead portion 34 of the terminal 31.

[0016] The upper insulating case 2B is substantially rectangular. An entrance hole 13 having a round cross section is formed in the center of the upper insulating case 2B. The entrance hole 13 penetrates the upper insulating case 2B. The central contact of a counterpart coaxial connector is supposed to be inserted into the entrance hole 13.

[0017] In addition, four round legs are disposed on the bottom surface (the other split surface) of the upper insulating case 2B. These legs are not shown in the figure. A groove 15 (see Fig. 7) having a V-shaped cross section is formed between the entrance hole 13 and an edge on which the fixed terminal 21 is led out. The groove 15 extends in a direction substantially perpendicular to the direction in which the fixed terminal 21 is led out.

[0018] Even though there is clearance arranged between the lower insulating case 2A and the lead portion 24 of the terminal 21 and the lead portion 34 of the terminal 31, when solder used for mounting is excessively applied, thereby exceeding a prescribed amount, a solder flux enters from spaces between the insulating cases 2A and 2B and the terminals 21 and 31. Thus, the groove 15 crossing with the fixed terminal 21 is disposed on the split surface of the upper insulating case 2B. With this groove 15, there is provided clearance for preventing capillary effect occurring between the insulating cases 2A and 2B and the fixed terminal 21. As a result, the flux cannot enter.

[0019] The fixed terminal 21 is typically formed by punching and bending a metal plate such as a flat stainless steel plate. The fixed terminal 21 is composed of a contact portion 22 with which the movable terminal 31 comes into contact, a fixed portion 23 sandwiched by the insulating cases 2A and 2B, and a lead portion 24 bent in an L-shape. Both sides of the contact portion 22 are folded at predetermined angles to form a horizontal

the insulating cases 2A and 2B. The movable contact portion 32 of the movable terminal 31 is arranged substantially horizontally in the inside space of the insulating-case structure. That is, the movable contact portion 32 is arranged in a direction substantially perpendicular to a direction in which the central contact of the counterpart coaxial connector is inserted.

[0031] Next, the function of the coaxial connector 1 will be illustrated with reference to Figs. 7 to 10.

[0032] As shown in Figs. 7 and 8, when the counterpart coaxial connector is not attached, the central part of the spring movable portion 38 curves upwardly. In this state, the movable terminal 31 is in contact with the fixed terminal 21 by the urging force due to the springing property of the spring movable portion 38, and both terminals 21 and 31 are electrically connected to each other.

[0033] In contrast, as shown in Figs. 9 and 10, when the counterpart coaxial connector is attached, the central part of the spring movable portion 38 is pressed down to be reversed by the central contact 65 of the counterpart coaxial connector inserted from the upper entrance hole 13, and the central part thereof extends downwardly in a circular form. In this situation, the contact portion 39 of the movable terminal 31 separates from the contact portion 22 of the fixed terminal 21 and thereby the fixed terminal 21 and the movable terminal 31 are electrically disconnected, while the central contact 65 and the movable terminal 31 are electrically connected. At the same time, the external conductor (not shown) of the counterpart coaxial connector is fitted into the external terminal 41 to be electrically connected to each other.

[0034] In the above situation, a reactive force occurs on both ends of the spring movable portion 38 (see Fig. 10). The reactive force is supported by the frame portion 37, particularly, by the folded parts A, B, C, and D formed on the two arms 37a. That is, as compared with the conventional movable terminal having only two folded parts shown in Fig. 12, the movable terminal 31 of the first embodiment has the four folded parts A, B, C, and D. As a result, the share load of the reactive force applied to each of the folded parts can be reduced. Thus, even though the movable terminal 31 is repeatedly pressed in contact with the central contact 65 of the counterpart coaxial connector and such a contact is continuously repeated for a long time, the plastic deformation of the movable terminal 31 hardly occurs and thereby the springing property of the movable terminal 31 is not deteriorated.

[0035] Furthermore, even if an excessive force is applied to the spring movable portion 38 when the counterpart coaxial connector is attached, since the lowest part of the spring movable portion 38 comes in contact with the upper surface of the lower insulating case 2A, the displacement of the spring movable portion 38 does not exceed a prescribed amount.

[0036] When the counterpart coaxial connector is removed from the coaxial connector 1, the central part of the spring movable portion 38 returns to an upwardly bulged state by using the springing property. In this state, the fixed terminal 21 and the movable terminal 31 are electrically connected to each other, while the central contact 65 and the movable terminal 31 are electrically disconnected from each other.

[Second Embodiment: Fig. 11]

[0037] A description will be given of a communications apparatus according to a second embodiment of the present invention by using an example of a mobile phone.

[0038] Fig. 11 shows an electric-circuit block diagram of an RF circuit of a mobile phone 120. In Fig. 11, reference numeral 122 denotes an antenna element, reference numeral 123 denotes a duplexer, reference numeral 125 denotes a selector switch, reference numeral 131 denotes a transmission-side isolator, reference numeral 132 denotes a transmission-side amplifier, reference numeral 133 denotes transmission-side interstage band pass filter, reference numeral 134 denotes a transmission-side mixer, reference numeral 135 denotes a reception-side amplifier, reference numeral 136 denotes a reception-side interstage band pass filter, reference numeral 137 denotes a reception-side mixer, reference numeral 138 denotes a voltage-controlled oscillator (VCO), and reference numeral 139 denotes a local band pass filter.

[0039] In this case, as the selector switch 125, the coaxial connector 1 in accordance with the first embodiment can be used. With this arrangement, for example, when the electrical characteristics of the RF circuit are checked in a process for manufacturing the mobile phone 120, by fitting a measurement probe (the counterpart coaxial connector) 126 connected to a measuring apparatus into the coaxial connector 1, a signal path from the RF circuit to the antenna element 122 can be switched to a signal path from the RF circuit to the measuring apparatus. When the measurement probe 126 is removed from the coaxial connector 1, the signal path from the RF circuit to the measuring apparatus is again switched to the signal path from the RF circuit to the antenna element 122. With the installation of the coaxial connector 1, the mobile phone 120 can obtain high reliability.

[Other embodiments]

[0040] The movable terminal, the coaxial connector, and the communications apparatus in accordance with the present invention are not restricted to the above embodiments. Various modifications and changes can be made without departing from the scope of the invention as defined in the claims.

[0041] In the above embodiments, the coaxial connector is formed by separately producing terminals and insulating cases to combine both of them. However, the

FIG. 1

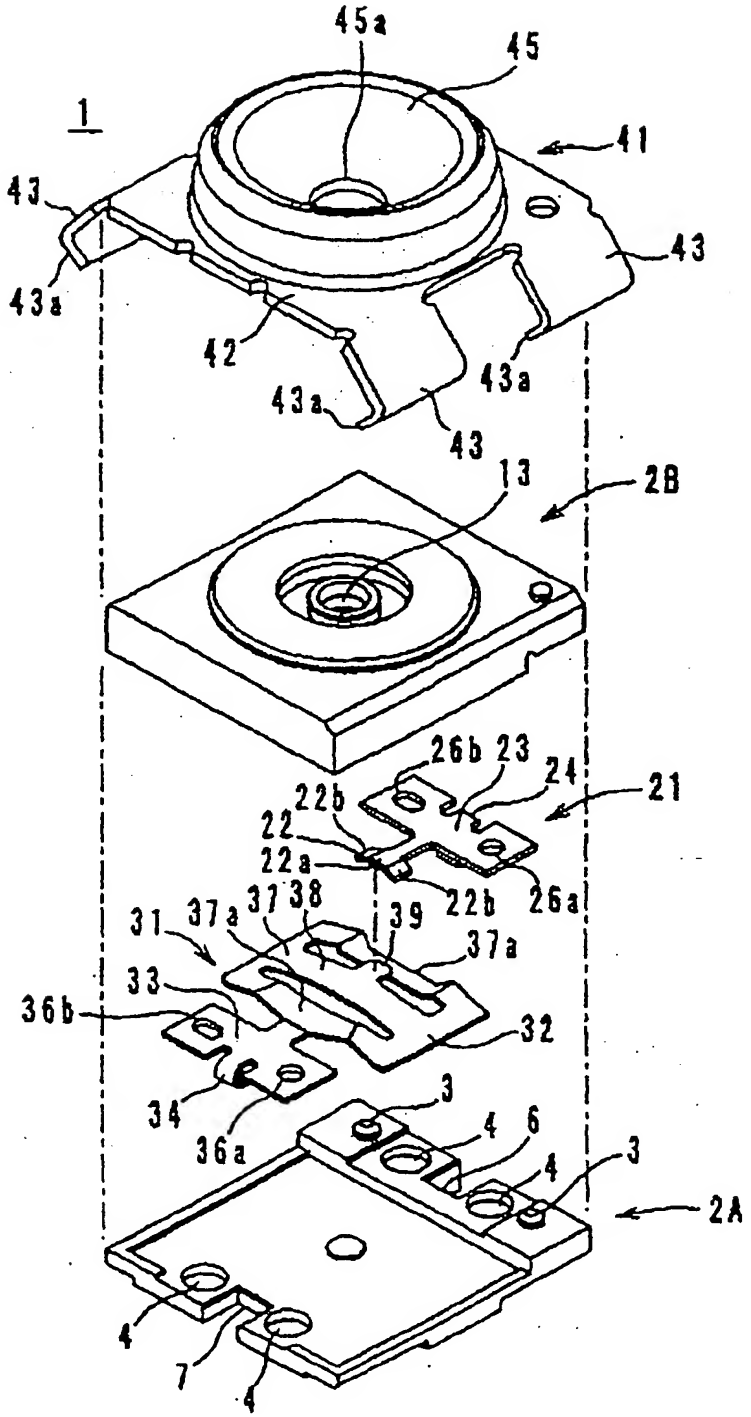
45a
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FIG. 6

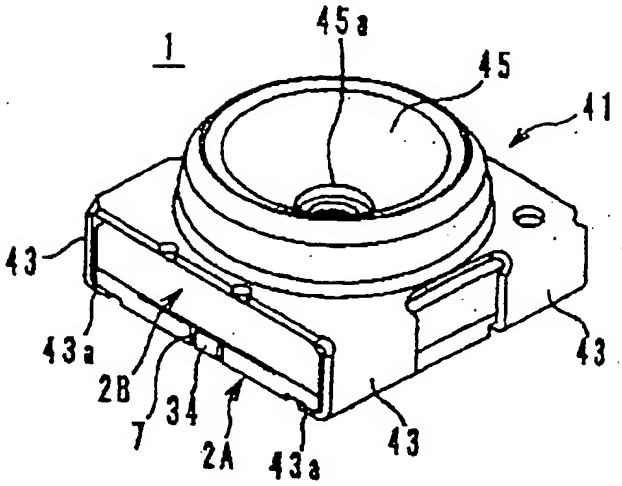


FIG. 7

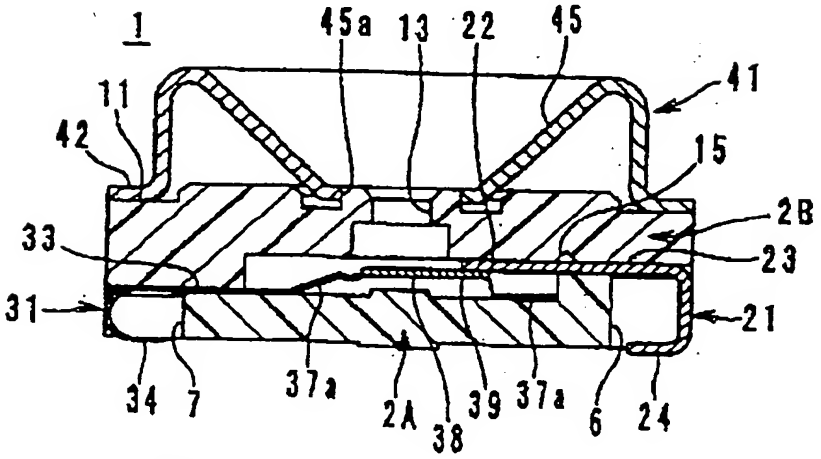


FIG. 8

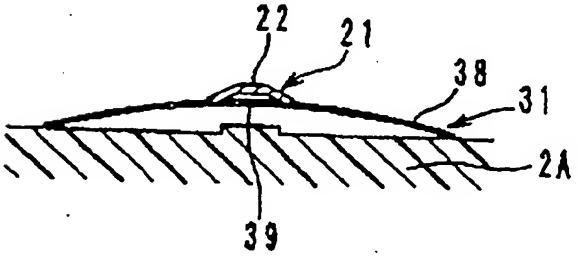
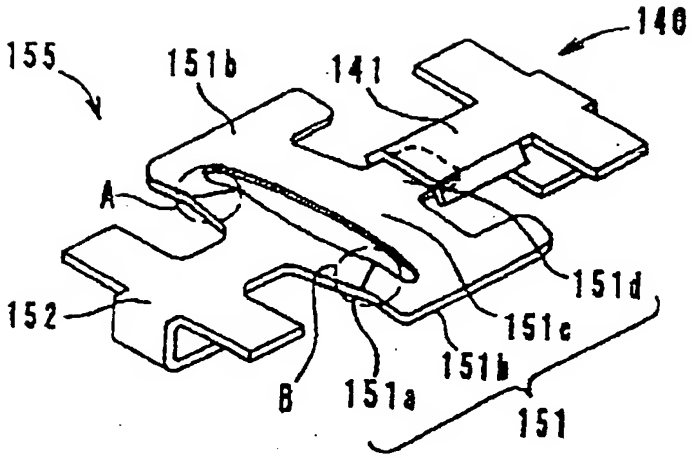


FIG. 12



ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 01 40 0033

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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28-03-2001

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